WHAT IS CLAIMED IS:

1. A method of manufacturing a semiconductor device, comprising the steps of:

(a) growing an InP layer on a surface of starting growth, resulting in the InP layer having a convex structure; and

(b) wet etching the InP layer by an etchant including hydrochloric acid and acetic acid, and thereby flattening a surface of the InP layer.

2. The method of manufacturing a semiconductor device as claimed in claim 1, wherein the convex structure results from a convex structure of the surface, in the step of (a).

3. The method of manufacturing a semiconductor device as claimed in claim 2, wherein the convex structure of the surface of starting growth is a mesa structure.

4. The method of manufacturing a semiconductor device as claimed in claim 2, wherein the convex structure of the surface of starting growth is a step structure.

5. The method of manufacturing a semiconductor device as claimed in claim 1, wherein the surface of starting growth is a flat surface and has a selective growth mask partially, and the convex structure is made as the convex structure corresponds to the selective growth mask, in the step of (a).

6. The method of manufacturing a semiconductor device as claimed in claim 1, wherein the InP layer has a flat surface comprised of at least one of a (100) surface, a (011) surface, or a (0-1-1) surface, after the step of (b) is completed.

7. The method of manufacturing a semiconductor device as claimed in claim 1, wherein the InP layer has a flat surface closer to at least one of a (100) surface, a (011) surface, or a (0-1-1) surface, after the step of (b) is completed.

8. The method of manufacturing a semiconductor device as claimed in claim 1, wherein a lower surface of the InP layer than a highest position of the surface of starting growth is made in the step of (a), and the InP layer has a flat surface locating at a height position corresponding to a lowest position of the InP layer from a surface of a substrate, after the step of (b) is completed.

9. The method of manufacturing a semiconductor device as claimed in claim 1, wherein a same positioned or higher surface of the InP layer than a highest position of the surface of starting growth is made in the step of (a), and the InP layer has a flat surface locating at a height position corresponding to a highest position of the surface of starting growth from a surface of a substrate, after the step of (b) is completed.

10. The method of manufacturing a semiconductor device as claimed in claim 2, wherein a selective growth mask is provided at part of the convex structure, and the convex structure of the InP layer is formed as corresponding to an edge of the selective growth mask, in the step of (a).

11. The method of manufacturing a semiconductor device as claimed in claim 2, wherein a slope area is formed along a side surface of the convex structure on the surface of starting growth by the convex structure of the InP layer, in the step of (a).

12. The method of manufacturing a semiconductor device as claimed in claim 2, wherein the InP layer is formed on the surface of starting growth and the convex step structure is covered with

the InP layer on the surface of starting growth by the convex structure of the InP layer, in the step of (a).

13. The method of manufacturing a semiconductor device as claimed in claim 1, wherein the etchant includes hydrochloric acid and acetic acid, as a density of acetic acid is maximum 20 times of a density of hydrochloric acid.

14. The method of manufacturing a semiconductor device as claimed in claim 1, wherein the etchant further includes an application material comprised of water or hydrogen peroxide water.

15. The method of manufacturing a semiconductor device as claimed in claim 14, wherein the hydrogen peroxide water having a density of maximum 30% of hydrochloric acid against hydrochloric acid and acetic acid is added into the etchant by the application material.

16. The method of manufacturing a semiconductor device as claimed in claim 14, wherein the application material is comprised of water.

17. The method of manufacturing a semiconductor device as claimed in claim 14, wherein the application material is comprised of water and hydrogen peroxide water.

18. A method of manufacturing a semiconductor device, comprising the steps of:

(a) etching an InP layer which shoulders a selective etching mask, has a lower surface area than the selective etching mask, and has a convex structure on a surface of the InP layer, by an etchant including hydrochloric acid and acetic acid; and

(b) flattening a surface of the InP layer except an area under the selective etching mask.

19. The method of manufacturing a semiconductor device as claimed in claim 18, wherein a convex structure of the InP layer results from a convex structure part of a surface of starting growth.

20. The method of manufacturing a semiconductor device as claimed in claim 19, wherein the selective etching mask is provided on an upper part of the convex structure part on the surface of starting growth.

21. The method of manufacturing a semiconductor device as claimed in claim 18, wherein the selective etching mask is provided on a surface of the convex structure part on the InP layer.

22. The method of manufacturing a semiconductor device as claimed in claim 18, wherein the selective etching mask is selected from a group of a compound semiconductor other than InP and an insulating material.

23. The method of manufacturing a semiconductor device as claimed in claim 22, wherein the selective etching mask is made of silicon oxide, silicon nitride, InGaAs, InGaAsP, AlGaInP, AlGaAs, or GaInNAs.

24. The method of manufacturing a semiconductor device as claimed in claim 18, wherein the etchant includes hydrochloric acid and acetic acid, as a density of acetic acid is maximum 20 times of a density of hydrochloric acid.

25. The method of manufacturing a semiconductor device as claimed in claim 18, wherein

the etchant further includes an application material comprised of water or hydrogen peroxide water.

26. The method of manufacturing a semiconductor device as claimed in claim 25, wherein the hydrogen peroxide water having a density of maximum 30% of hydrochloric acid against hydrochloric acid and acetic acid is added into the etchant by the application material.

27. The method of manufacturing a semiconductor device as claimed in claim 25, wherein the application material is made of water.

28. A method of manufacturing a semiconductor device, comprising the steps of:

(a) forming a semiconductor structure in which first to fourth semiconductor layers are grown, wherein the first semiconductor layer made of n-type InP is grown on a n-type InP substrate, the second semiconductor layer having a smaller band gap than InP is grown on the first semiconductor layer, the third semiconductor layer made of p-type InP is grown on the second semiconductor layer, and the fourth semiconductor layer made of InGaAs or InGaAsP is grown on the third semiconductor layer;

(b) etching the semiconductor structure in which the semiconductor layers are grown, and

thereby a mesa stripe is formed on part including at least the second to forth semiconductor layers;

(c) growing a fifth semiconductor layer on the InP substrate on which the mesa stripe is formed, as a lowest surface height of the fifth semiconductor layer from a surface of the substrate is higher than the fourth semiconductor layer; and

(d) etching a surface of the fifth semiconductor layer by an etchant including hydrochloric acid and acetic acid.

29. A method of manufacturing a semiconductor device, comprising the steps of:

(a) forming a semiconductor structure in which first to fourth semiconductor layers are grown, wherein the first semiconductor layer made of n-type InP is grown on a n-type InP substrate, the second semiconductor layer having a smaller band gap energy than InP is grown on the first semiconductor layer, the third semiconductor layer made of p-type InP is grown on the second semiconductor layer, and the fourth semiconductor layer of InGaAs or InGaAsP is grown on the third semiconductor layer;

(b) etching the semiconductor structure in which the semiconductor layers are grown, and thereby a mesa stripe is formed on part including at least the second to forth semiconductor layers;

(c) growing a fifth semiconductor layer on the InP substrate on which the mesa stripe is formed, as a lowest surface height of the fifth semiconductor layer from a surface of the substrate is higher than the fourth semiconductor layer and as the mesa stripe is covered with the fifth semiconductor layer; and

(d) etching a surface of the fifth semiconductor layer by an etchant including hydrochloric acid and acetic acid.

30. A method of manufacturing a semiconductor device, comprising the steps of:

(a) forming a semiconductor structure in which first to third semiconductor layers are grown, wherein the first semiconductor layer made of n-type InP is grown on a n-type InP substrate, the second semiconductor layer having a smaller band gap than InP is grown on the first semiconductor layer, and the third semiconductor layer made of p-type InP is grown on the second semiconductor layer;

(b) etching the semiconductor structure by using a protection pattern formed on the semiconductor structure as a mask, and thereby a mesa stripe including at least the second and third semiconductor layers is formed;

(c) growing a forth semiconductor layer made of p-type InP on the InP substrate on which the mesa stripe is formed, as a lowest surface height of the forth semiconductor layer from a surface of the substrate is higher than an upper surface of the second semiconductor layer and lower than the third semiconductor layer;

(d) etching a surface of the forth semiconductor layer by an etchant including hydrochloric acid and acetic acid;

(e) growing a fifth semiconductor layer made of n-type InP on the forth semiconductor layer;

(f) removing the protection pattern used as a mask in the step of (a) by etching; and

(g) growing a sixth semiconductor layer

made of p-type InP on the third and fifth semiconductor layers, and growing a seventh semiconductor layer of InGaAs or InGaAsP on the sixth semiconductor layer.

31. A method of manufacturing a semiconductor device, comprising the steps of:

(a) forming a semiconductor structure in which first to fourth semiconductor layers are grown, wherein the first semiconductor layer made of n-type InP is grown on an n-type InP substrate, the second semiconductor layer having a smaller band gap than InP is grown on the first semiconductor layer, the third semiconductor layer made of p-type InP is grown on the second semiconductor layer, and the fourth semiconductor layer of InGaAs or InGaAsP is grown on the third semiconductor layer;

(b) etching the semiconductor structure by using a protection pattern formed on the semiconductor structure as a mask, and thereby a mesa stripe including at least the second to forth semiconductor layers is formed;

(c) removing the protection pattern by etching;

(d) growing a fifth semiconductor layer made of p-type InP on the substrate where the mesa stripe is formed, as a lowest surface height of the fifth semiconductor layer from a surface of the substrate is higher than the second semiconductor layer and is lower than the forth semiconductor layer and as the mesa stripe is included;

(e) etching a surface of the fifth semiconductor layer by an etchant including hydrochloric acid and acetic acid;

(f) growing a sixth semiconductor layer made of n-type InP on the fifth semiconductor layer, as a lowest surface height of the sixth semiconductor layer from a surface of the substrate is lower than the forth semiconductor layer;

(g) etching a surface of the sixth semiconductor layer by an etchant including hydrochloric acid and acetic acid;

(h) growing a seventh semiconductor layer made of p-type InP, as a lowest surface height of the seventh semiconductor layer from a surface of the substrate is higher than the forth semiconductor layer; and

(i) etching a surface of the seventh semiconductor layer by an etchant including hydrochloric acid and acetic acid.

32. A method of manufacturing a semiconductor device, comprising the steps of:

(a) forming a semiconductor structure in which first to fourth semiconductor layers are grown, wherein the first semiconductor layer made of n-type InP is grown on an n-type InP substrate, the second semiconductor layer having a smaller band gap energy than InP is grown on the first semiconductor layer, the third semiconductor layer made of p-type InP is grown on the second semiconductor layer, and the fourth semiconductor layer of InGaAs or InGaAsP is grown on the third semiconductor layer;

(b) etching the semiconductor structure by using a protection pattern formed on the semiconductor structure as a mask, and thereby a mesa stripe including at least the second to forth semiconductor layers is formed;

(c) removing the protection pattern by etching;

(d) growing a fifth semiconductor layer made of p-type InP on the substrate where the mesa stripe is formed, as a lowest surface height of the fifth semiconductor layer from a surface of the substrate is higher than the second semiconductor layer and lower than the forth semiconductor layer and as the mesa stripe is included;

(e) etching a surface of the fifth semiconductor layer by an etchant including hydrochloric acid and acetic acid;

(f) growing a sixth semiconductor layer made of n-type InP on the fifth semiconductor layer, and growing a seventh semiconductor layer made of p-type InP on the sixth semiconductor layer;

(g) etching a surface of the seventh semiconductor layer by an etchant including hydrochloric acid and acetic acid;

(h) removing the forth semiconductor layer by etching; and

(i) growing an eighth semiconductor layer made of p-type InP, and growing a ninth semiconductor layer made of InGaAs or InGaAsP on the eighth semiconductor layer.

33. A method of manufacturing a semiconductor device, comprising the steps of:

(a) forming a semiconductor structure in which first to fourth semiconductor layers are grown, wherein the first semiconductor layer made of n-type InP is grown on an n-type InP substrate, the second semiconductor layer having a smaller band gap than InP is grown on the first semiconductor layer, the

third semiconductor layer made of p-type InP is grown on the second semiconductor layer, and the fourth semiconductor layer of InGaAs or InGaAsP is grown on the third semiconductor layer;

(b) etching the semiconductor structure, and thereby a mesa stripe including at least the second to forth semiconductor layers is formed;

(c) growing a fifth semiconductor layer on the substrate where the mesa stripe is formed, as a contact part height between the fifth semiconductor layer and the mesa stripe from a surface of the substrate is higher than the second semiconductor layer and lower than the forth semiconductor layer and as the mesa stripe is included;

(d) growing a sixth semiconductor layer made of p-type InP on the fifth semiconductor layer; and

(e) etching a surface of the sixth semiconductor layer by an etchant including hydrochloric acid and acetic acid.

34. A method of manufacturing a semiconductor device, comprising the steps of:

(a) forming a semiconductor structure in which first to fourth semiconductor layers are grown, wherein the first semiconductor layer made of n-type InP is grown on an n-type InP substrate, the second semiconductor layer having a smaller band gap than InP is grown on the first semiconductor layer, the third semiconductor layer made of p-type InP is grown on the second semiconductor layer, and the fourth semiconductor layer of InGaAs or InGaAsP is grown on the third semiconductor layer;

(b) etching the semiconductor structure by

using a protection pattern formed on the semiconductor structure as a mask, and thereby a mesa stripe including the third and forth semiconductor layers is formed;

(c) removing the protection pattern by etching;

(d) growing a fifth semiconductor layer made of n-type InP on the substrate where the mesa stripe is formed, as a lowest surface height of the fifth semiconductor layer from a surface of the substrate is lower than the forth semiconductor layer;

(e) etching a surface of the fifth semiconductor layer by an etchant including hydrochloric acid and acetic acid;

(f) growing a sixth semiconductor layer made of p-type InP on the fifth semiconductor layer, as a lowest surface height of the sixth semiconductor layer from a surface of the substrate is higher than the forth semiconductor layer; and

(g) etching a surface of the sixth semiconductor layer by an etchant including hydrochloric acid and acetic acid.

35. A method of manufacturing a semiconductor device, comprising the steps of:

(a) forming a semiconductor structure in which first to fourth semiconductor layers are grown, wherein the first semiconductor layer made of n-type InP is grown on an n-type InP substrate, the second semiconductor layer having a smaller band gap than InP is grown on the first semiconductor layer, the third semiconductor layer made of p-type InP is grown on the second semiconductor layer, and the

fourth semiconductor layer of InGaAs or InGaAsP is grown on the third semiconductor layer;

(b) etching the semiconductor structure, and thereby a mesa stripe including the third and forth semiconductor layers is formed;

(c) growing a fifth semiconductor layer made of n-type InP on the substrate where the mesa stripe is formed, as a highest part height of the fifth semiconductor layer from a surface of the substrate is lower than the forth semiconductor layer;

(d) etching a surface of the fifth semiconductor layer by an etchant including hydrochloric acid and acetic acid;

(e) growing a sixth semiconductor layer made of p-type InP on the fifth semiconductor layer, as a lowest part height of the sixth semiconductor layer from a surface of the substrate is higher than the forth semiconductor layer; and

(f) etching a surface of the sixth semiconductor layer by an etchant including hydrochloric acid and acetic acid.

36. A method of manufacturing an optical wave guide, comprising the steps of:

(a) forming a semiconductor structure, wherein the first semiconductor layer made of InP is grown on an InP substrate, the second semiconductor layer having a larger refractive index than a refractive index of the first semiconductor layer is grown on the first semiconductor layer, and the third semiconductor layer made of InP is grown on the second semiconductor layer;

(b) etching the semiconductor structure by

using a protection pattern formed on the semiconductor structure as a mask, and thereby a mesa pattern including at least the second and third semiconductor layers is formed;

(c) growing a forth semiconductor layer made of InP on the substrate where the mesa stripe is formed in a state where the protection pattern is shouldered by the mesa pattern;

(d) etching a surface of the forth semiconductor layer in a state where the protection pattern is shouldered by the mesa pattern, by an etchant including hydrochloric acid and acetic acid;

(e) removing the protection pattern; and

(f) growing a fifth semiconductor layer made of InP.

37. A method of manufacturing an optical wave guide, comprising the steps of:

(a) forming a semiconductor structure, wherein a first semiconductor layer made of InP is grown on an InP substrate, a second semiconductor layer having a larger refractive index than a refractive index of the first semiconductor layer is grown on the first semiconductor layer, a third semiconductor layer made of InP is grown on the second semiconductor layer, and a forth semiconductor layer made of InGaAs or InGaAsP is grown on the third semiconductor layer;

(b) forming a mesa pattern including at least the second to forth semiconductor layers by etching the semiconductor structure;

(c) growing a fifth semiconductor layer made of InP on the substrate where the mesa pattern is formed, as the mesa pattern is covered; and

(d) etching a surface of the fifth semiconductor layer by an etchant including hydrochloric acid and acetic acid.

38. A method of manufacturing a semiconductor device, comprising the steps of:

(a) forming a selective growth mask on an InP substrate;

(b) forming a semiconductor pattern by selectively growing a first semiconductor layer made of InP on an InP substrate where the selective growth mask is formed, selectively growing a second semiconductor layer having a smaller band gap than InP on the first semiconductor layer, and selectively growing a third semiconductor layer made of InP on the second semiconductor layer; and

(c) etching a surface of the third semiconductor layer by etchant including hydrochloric acid and acetic acid.

39. A method of manufacturing a semiconductor device, comprising the steps of:

(a) forming a selective growth mask on an InP substrate;

(b) forming a groove by etching uncovered area by the selective etching mask on a surface of the InP substrate;

(c) forming a semiconductor structure by growing a first semiconductor layer made of InP on the substrate, growing a second semiconductor layer having a smaller band gap than InP on the first

semiconductor layer, and growing a third semiconductor layer made of InP on the second semiconductor layer, in a state where the selective growth mask is formed on the substrate;

(d) removing the selective growth mask; and

(e) etching a surface of the third semiconductor layer by etchant including hydrochloric acid and acetic acid.

40. A method of manufacturing a multiple layer optical wave guide, comprising the steps of:

(a) forming a first growing semiconductor structure by growing a first semiconductor layer made of InP on an InP substrate, growing a second semiconductor layer having a smaller band gap than InP on the first semiconductor layer, and growing a third semiconductor layer made of InP on the second semiconductor layer;

(b) forming a first mesa stripe including at least the second and third semiconductor layers by forming a first protection pattern on the first growing semiconductor structure and etching the first growing semiconductor structure with the first protection pattern as a mask;

(c) growing a forth semiconductor layer made of InP having a high resistance on the substrate where the first mesa stripe is formed, in a state where the first protection pattern remains on the first mesa stripe;

(d) etching a surface of the forth semiconductor layer by etchant including hydrochloric acid and acetic acid;

(e) removing the first protection pattern;

(f) forming a second semiconductor structure by growing a fifth semiconductor layer made of InP on the forth semiconductor layer, growing a sixth semiconductor layer having a smaller band gap than InP on the fifth semiconductor layer, and growing a seventh semiconductor layer made of InP on the sixth semiconductor layer;

(g) forming a second mesa stripe including at least the sixth and seventh semiconductor layers by forming a second protection pattern on the second semiconductor structure and etching the second semiconductor structure with the second protection pattern as a mask;

(h) growing an eighth semiconductor layer made of InP on the first semiconductor structure where the second mesa stripe is formed, in a state where the second protection pattern remains on the second mesa stripe;

(i) etching a surface of the eighth semiconductor layer by etchant including hydrochloric acid and acetic acid; and

(j) removing the second protection pattern by etching.